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An electrosurgical apparatus comprising a bipolar electrode, and means for generating uniform bursts of high frequency signals (12) having a periodic waveform. The apparatus further comprises means for impressing substantially identical decaying amplitude envelopes (20) on said uniform bursts, and means (30) for applying said impressed bursts to said electrode. Preferably, the periodic waveform is a sine wave form, and the decaying amplitude envelopes decay at a predetermined rate from a preselected initial amplitude. Also, preferably, each of the bursts of high frequency signals has a given time length, and successive bursts are separated by that same given time length.

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BIPOLAR ELECTROSURGICAL APPARATUS

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BACKGROUND OF THE INVENTION

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This invention generally relates to bipolar electrosurgical apparatus, and more specifically, to a bipolar cauterizer well suited for use during microsurgery such as micro ophthalmic surgery.

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Microsurgical procedures are gaining ever-increasing acceptance in the surgical community for performing precise, minimum invasive surgery for various parts of the body, and one particularly widespread microsurgical application is in the field of ophthalmology. In this application, commonly, a hand piece having a small tool is used either to cut or to mascerate the eye tissue while an irrigation or infusion liquid is brought to the surgery site. The cut or mascerated tissue is carried away from the surgical site by a suction conduit or tube to a collection vessel such as a bag or bottle. A cauterizer may be used to help control bleeding at the surgical site.

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Consoles are specifically designed for these ophthalmic procedures. These consoles are used to operate the tools and the suction and infusion lines used in the procedures, and to generate the light that is used to illuminate the surgical site. Typically, these consoles have a modular design and include a multitude of separable or removable modules, with each module being used to operate or to perform a specific task. For example, one module may be employed to operate the hand piece used to cut or mascerate the eye

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1 tissue, another module may be used to infuse and
aspirate the surgical site, and a third module may be
used to operate the cauterizer.

5 SUMMARY OF THE INVENTION

An object of this invention is to improve
bipolar cauterizers.

10 Another object of this invention is to apply a
damped sinusoidal wave form power signal to a bipolar
cauterizer.

15 These and other objectives are attained with
an electrosurgical apparatus comprising a bipolar
electrode, and means for generating uniform bursts of
high frequency signals having a periodic waveform. The
apparatus further comprises means for impressing
substantially identical decaying amplitude envelopes on
said uniform bursts, and means for applying said
impressed bursts to said electrode.

20 Preferably, the decaying amplitude envelopes
decay at a predetermined rate from a preselected initial
amplitude. Also, preferably, the periodic waveform is a
sine wave form. Each of the bursts of high frequency
signals has a given time length, and successive bursts
25 are separated by that same given time length.

30 Further benefits and advantages of the
invention will become apparent from a consideration of
the following detailed description given with reference
to the accompanying drawings, which specify and show
preferred embodiments of the invention.

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1 BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram illustrating an operating system for a bipolar coagulator.

5 Figures 2, 3 and 4 illustrate details of the blocks shown in Figure 1.

Figure 5 shows a portion of the output signal generated by an exponential decay circuit of the operating system of Figures 1-4.

10 Figure 6 shows a portion of a damped sine wave signal generated by the system of Figure 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

15 With reference to Figures 1-4, in system 10, a 1 megahertz sine wave oscillator 12 couples its output to an amplitude modulator circuitry (MC1495C) 14. The oscillator 12 generates a 1 megahertz sine wave of constant amplitude.

20 A timing control circuit 16, comprised of a timing circuit (LM556N) 20 generates an output pulse every 64 micro-seconds. This output pulse is applied to exponential decay damping circuit 20. In particular, the output pulse from circuit 16 operates a switch (SW201) 22, which discharges capacitor C6 of an RC
25 circuit 24, comprised of capacitor C6 and resistor R6, every 64 microseconds. The RC timing circuit 24 is coupled through (U5A) to pin 4 of amplitude modulation circuit 14 to apply a decaying signal, a portion of which is shown in Figure 5. In the preferred
30 embodiment, this signal has a maximum amplitude at 64

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1 microsecond intervals and decays to zero amplitude in
less than 64 microseconds.

 The decaying signal modulates the 1 megahertz
sine wave signal at amplitude modulation circuitry 14,
5 to generate a damped sine wave signal, as represented in
Figure 6. This damped sine wave signal is initiated at
a constant periodicity of 64 microseconds and is applied
to gain control preamplifier 30, which may be used to
adjust the amplitude of the signal. From preamplifier
10 30, the signal is applied to phasing circuits (U12 and
U13) 32, which convert the input signal into a pair of
output signals 180° out of phase with one another.

 These two output signals are applied to a gain
control circuit (AD539) 34, which controls the amplitude
15 of the phase signals. The phase signals are then
applied, through push-pull driver circuits 36, to the
inputs of class B push-pull power MOSFETs 40. The
outputs of the push-pull class B amplifiers are coupled
to the primary winding of transformer 42; and the output
20 of the transformer 42 is coupled, via connector 44, to
the bipolar electrode forceps, which may be a
conventional bipolar coagulator.

 Block 46 represents a power supply for
transformer 42; and, for example, this power supply may
25 be a 24V to 200V step up DC to DC converter.

 The duty cycle of the system 10 is controlled
by second timer circuit (LM556) 50. The duty cycle
output of this circuit 50 is coupled to one input of
gate (U19C) 52, which grounds the power level control
input by means of switch (SW201) 54. Preferably, the
30 duty cycle is one second on, one second off--that is,

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1 the power signal is applied to the forceps for one
second, with successive applications of the power signal
being one second apart.

5 As represented in Figure 1, various parameters
or operating conditions of system 10 may be sensed by
appropriate fault detectors 56, which generate one or
more signals that may represent those perimeters.

10 System 10 may be used for a variety of
purposes and in a variety of specific application. For
example, system 10 may be used during ophthalmic surgery
to cauterize the surgical site. Even more specifically,
system 10 is very well suited for use in a modular
console that includes a multitude of other modules for
operating other instruments or for performing other
15 tasks related to ophthalmic surgery. For example,
system 10 may be used in the console disclosed in
co-filed PCT application no. _____ for which priority
is based on U.S. s/n 08/330,926 (Attorney docket PD-4395),
the disclosure of which is herein incorporated by reference.

20 In such an application system 10 or the
console includes processor 60. The console processor,
generally, may be used to control the overall operation
of the console and to act as a communications interface
between the console and the operator. Also, commands to
25 activate or enable power system 10 may be generated by
the console processor and transmitted to system 10 via
enable circuit 62. Data transmitted in or by system 10
may be transmitted to the console processor to keep that
processor, and the console operator, informed of that
30 data.

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1 In Figure 1, block 64, represents an
electronics module identification block, which is
provided with an electronically readable serial number,
identifying the power system.

5 While it is apparent that the invention herein
disclosed is well calculated to fulfill the objects
previously stated, it will be appreciated that numerous
modifications and embodiments may be devised by those
skilled in the art, and it is intended that the appended
10 claims cover all such modifications and embodiments as
fall within the true spirit and scope of the present
invention.

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1 CLAIMS

5 1. Electrosurgical apparatus comprising:
 a bipolar electrode;
 means for generating uniform bursts of a high
frequency signal having a periodic waveform;
 means for impressing substantially identical
decaying amplitude envelopes on said uniform bursts; and
 means for applying said impressed bursts to
10 said electrode.

2. Apparatus according to Claim 1, wherein
each of said envelopes has a predetermined rate of decay
from a preselected initial amplitude.

15 3. Apparatus according to Claim 2, wherein
said predetermined rate of decay is an exponential rate
of decay.

4. Apparatus according to Claim 1, wherein
said periodic waveform is a sine wave form.

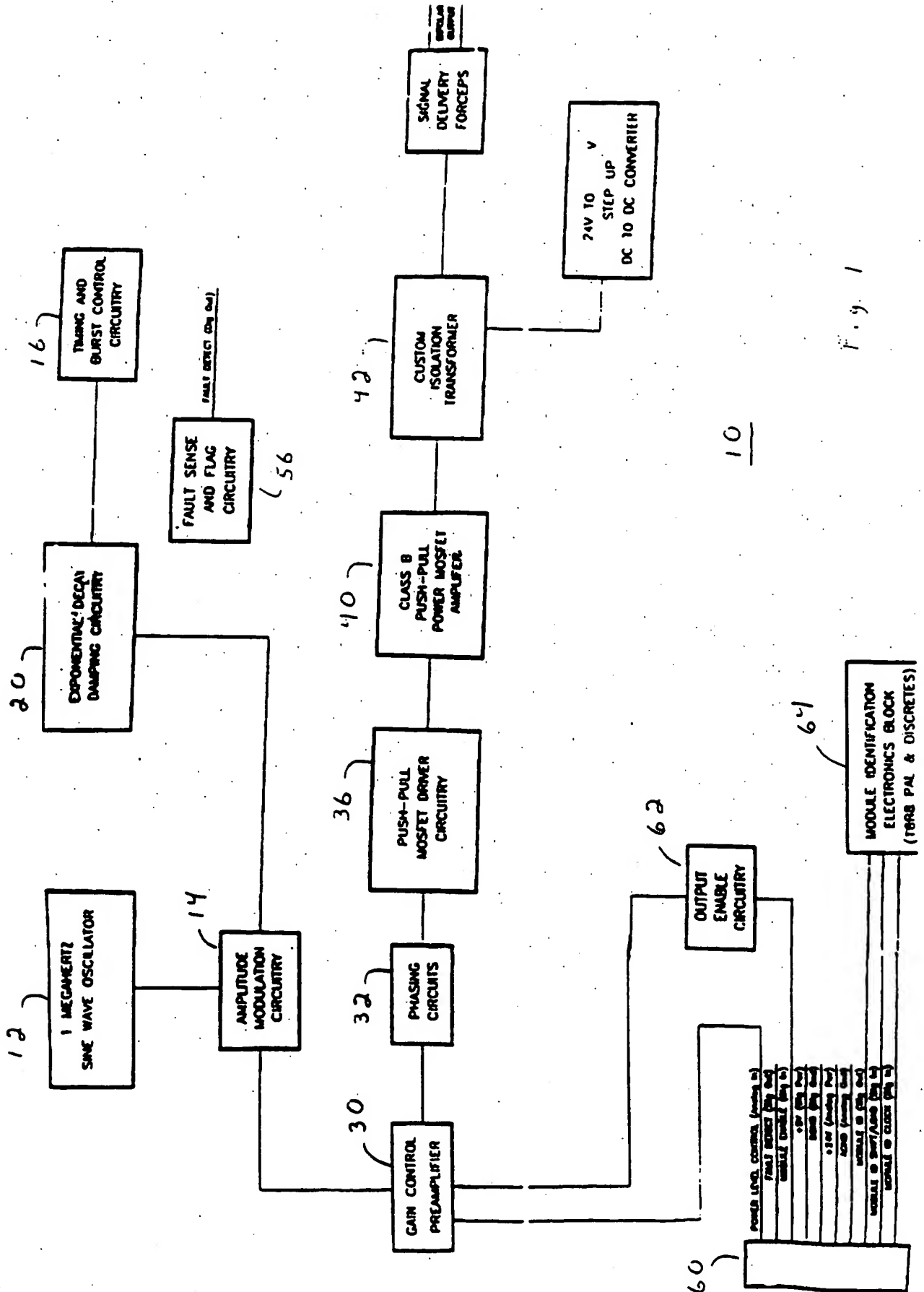
20 5. Apparatus according to Claim 1, wherein
said periodic waveform has a frequency of approximately
one megahertz.

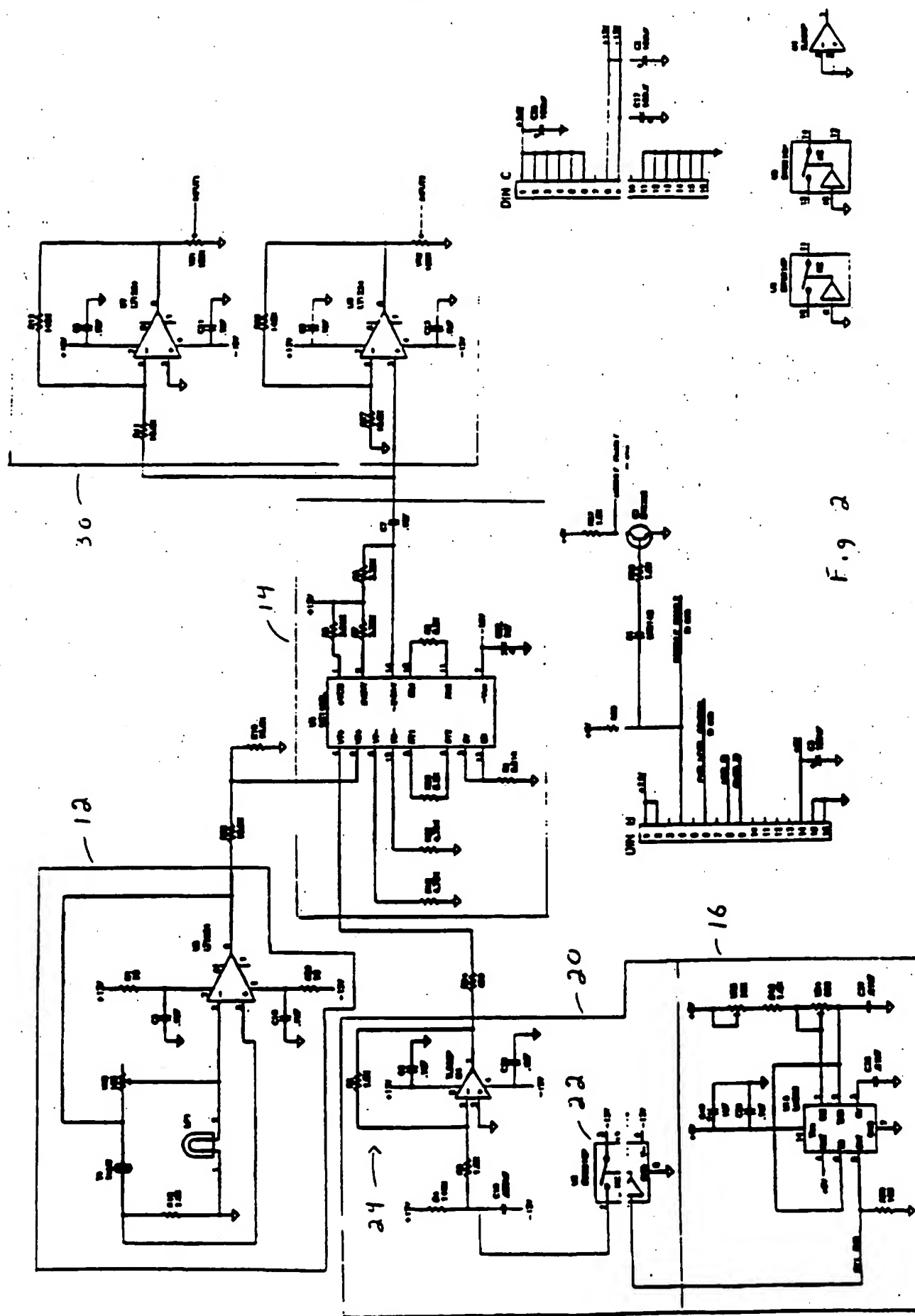
6. Apparatus according to Claim 1, wherein
the generating means separates adjacent bursts.

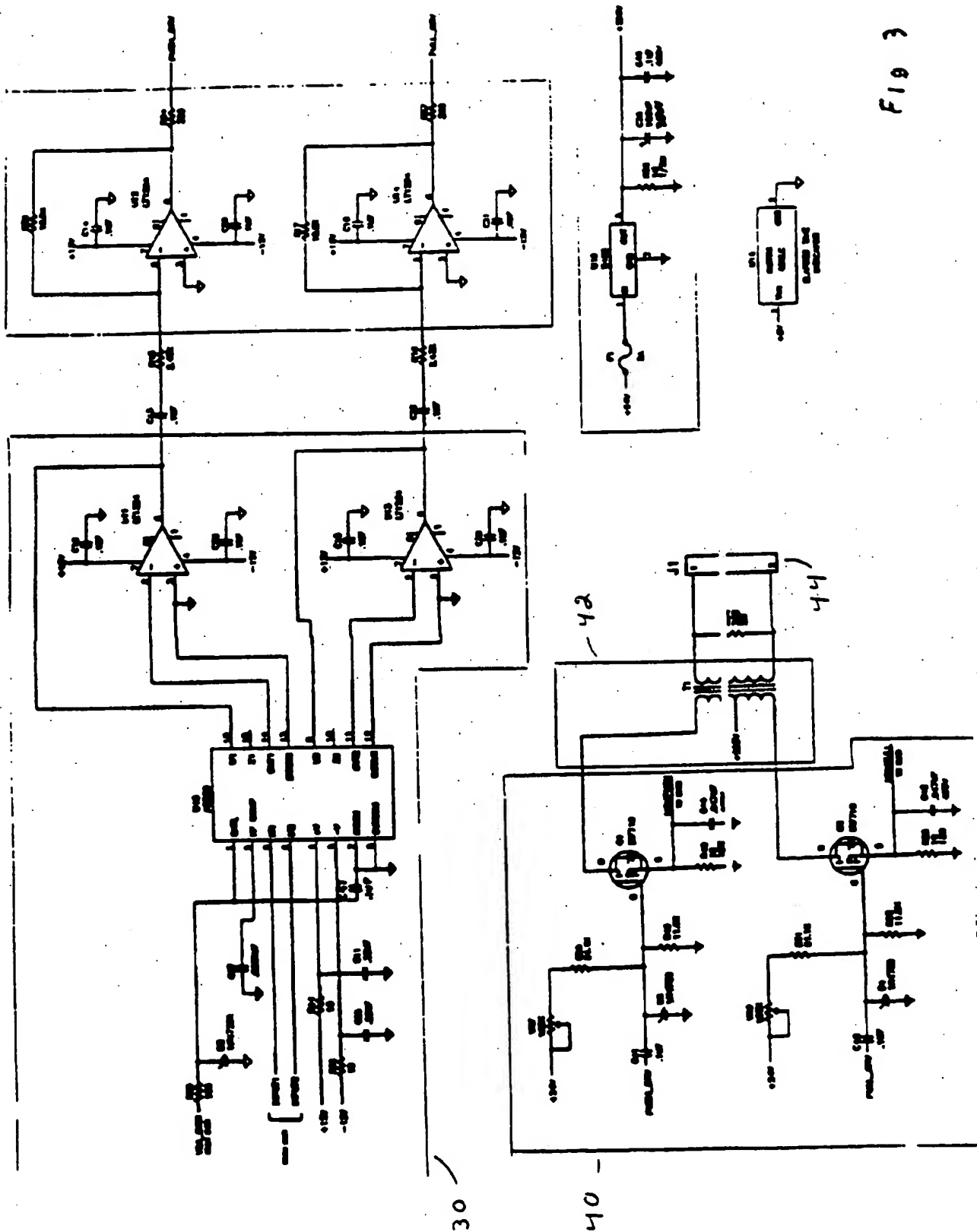
25 7. Apparatus according to Claim 1, wherein:
each of said bursts has a length equal to a
given period of time; and

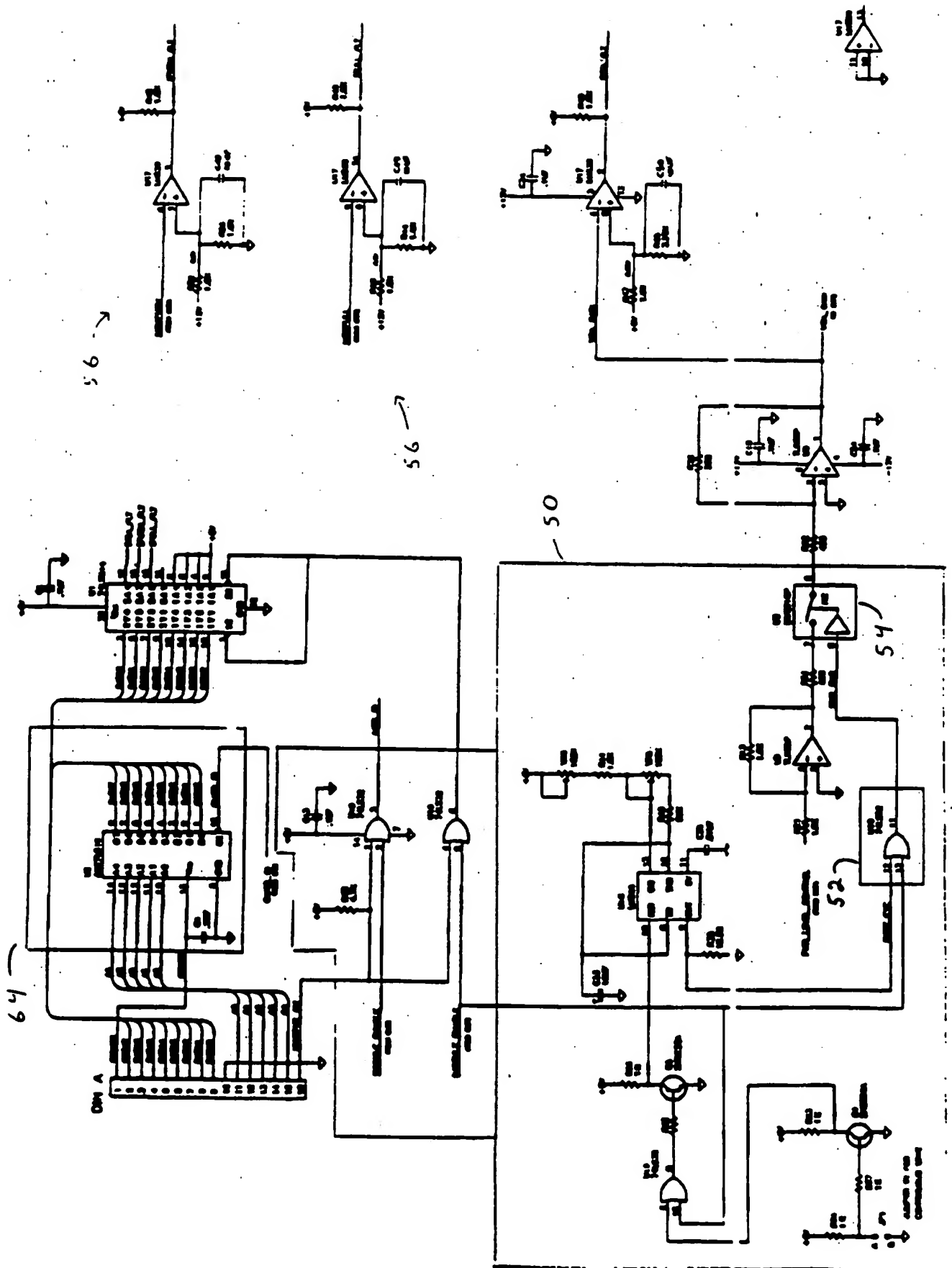
 successive bursts are separated by said given
period of time.

30 8. Apparatus according to Claim 7, wherein
said given period of time is approximately one second.









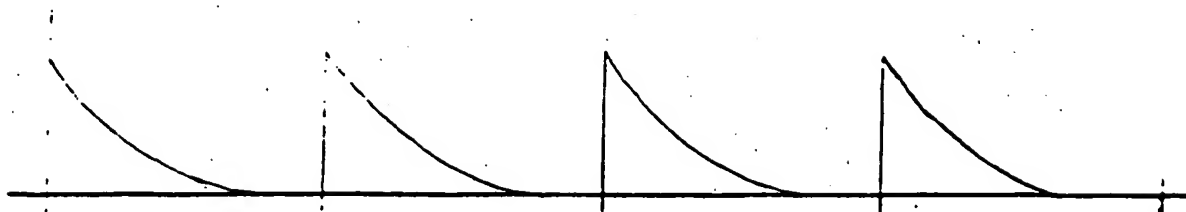


Fig. 5

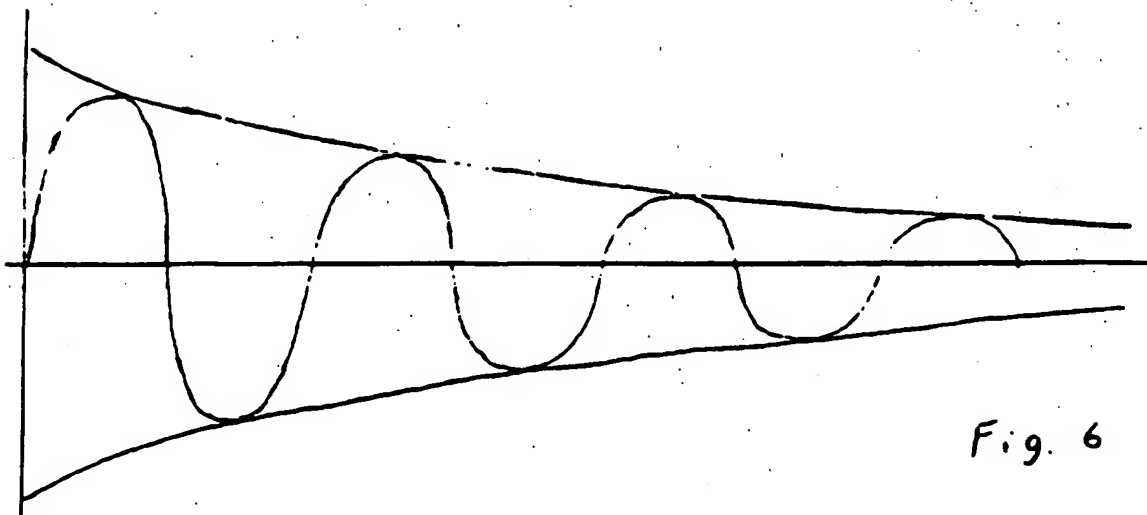


Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/13858

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :A61B 17/39

US CL :606/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 606/32-34, 37-42

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US, A, 5,318,563 (MALIS ET AL.) 07 June 1994, see whole document.	1-8 ----- 1-8
A	US, A, 3,923,063 (ANDREWS ET AL/) 02 December 1975, see whole document.	1-8
A	US, A, 5,167,660 (ALTENDORF) 01 December 1992, see whole document.	1-8

☐ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents:	* T	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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Date of the actual completion of the international search

28 MARCH 1996

Date of mailing of the international search report

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